2: PROPOSED ACTION AND ALTERNATIVES

2.1 Approach to Alternatives

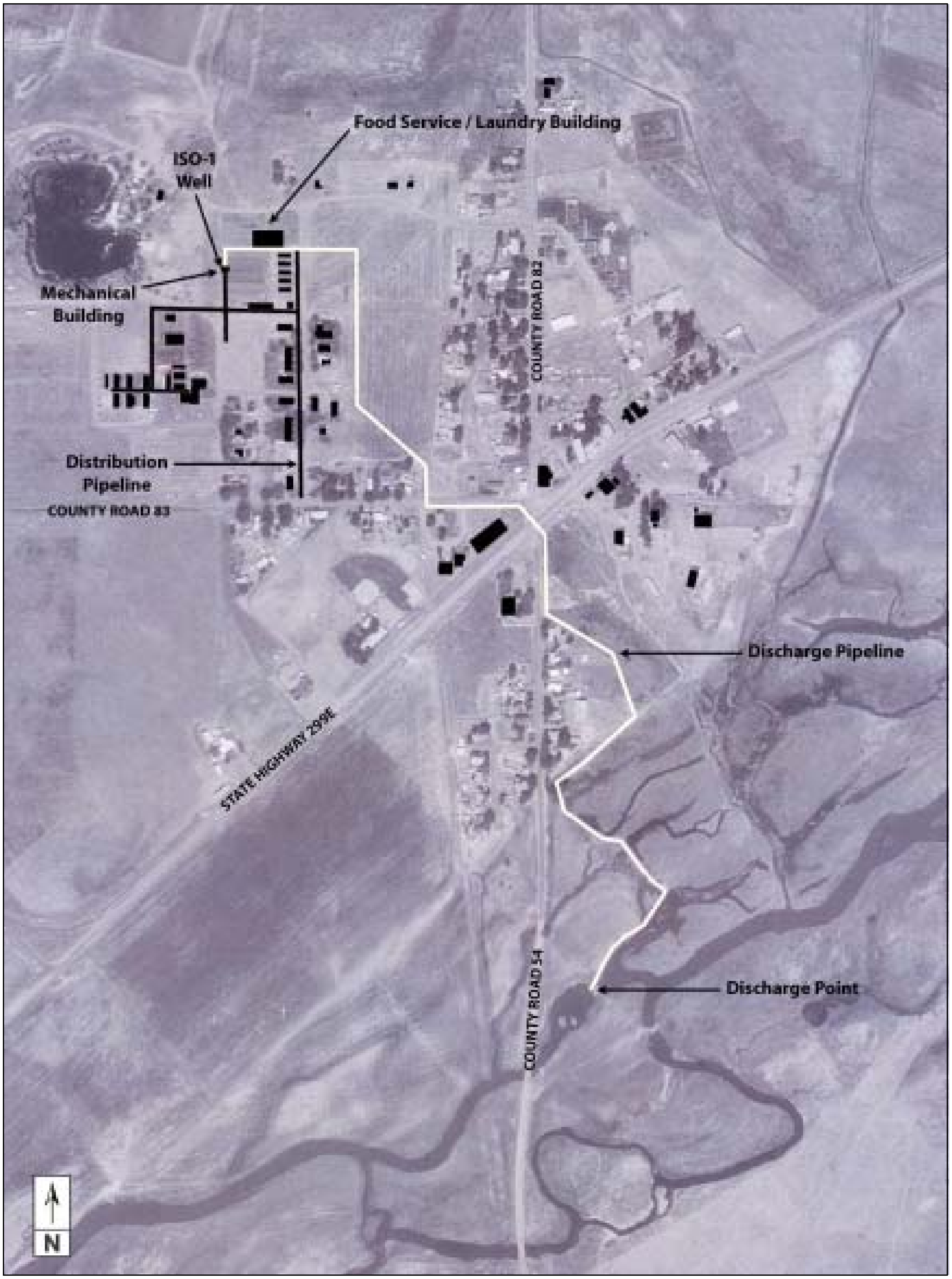
This chapter of the EA provides a detailed description of the alternatives, including the proposed action. NEPA requires that a reasonable range of alternatives be considered that could feasibly meet the objectives of the proposed action as defined in the purpose and need for the project described in Section 1.2 [CFR 1502.14(a)]. I'SOT evaluated a range of project alternatives during the scoping phase of the initial environmental review process. The proposed action would meet the purpose and need of the project to the greatest extent with the least environmental effects.

2.2 Alternative A–Proposed Action

2.2.1 LOCATION

The proposed project is located at the I'SOT facility in Canby, Modoc County, California. Figure 1.1-1 illustrates the regional area, and Figure 2.2-1 illustrates the location of the proposed project sites within the I'SOT facility. The existing geothermal well (ISO-1) is located on Section 25, Township 42 North, Range 9 East Mount Diable Base & Meridian (MDB&M). The distribution piping would extend from the new mechanical building adjacent to the well to the 34 existing separate I'SOT buildings totaling approximately 50,000 square feet. The retrofitted buildings include several older single-wide or double-wide modular homes, small wood-frame single-family homes, wood-frame group homes, and community buildings located within the I'SOT community north of County Road 83 and east of County Road 82.

Figure 2.2-1: Proposed Project Components



SOURCE: USGS Orthophoto, MHA, Inc. 2002

2.2.2 OVERVIEW OF THE PROPOSED ACTION

The proposed action is to implement a district heating system that would include production of geothermal fluids from an existing well, construction of a food service and laundry building, construction of a mechanical building with distribution piping, retrofitting water and space heating systems, and construction of an effluent discharge pipeline terminating at the Pit River. A potential future phase of this project could include drilling of an additional well to facilitate the injection of geothermal fluid and eliminate the discharge to the Pit River. This future phase is projected to occur in 5 to 10 years, contingent on funding sources.

I'SOT proposes several activities on their privately held property in the town of Canby. I'SOT proposes to:

- Produce up to 60 gallons per minute of geothermal fluid from an existing well (estimated peak demand flow rate is 37 gpm);
- Construct a mechanical and control building;
- Construct a food service and laundry building;
- Construct and operate a district heating system that would utilize the local geothermal resource (naturally occurring hot groundwater) as the heat source;
- Retrofit existing water heaters and space heaters to use community water heated by the geothermal fluid;
- Construct a geothermal effluent treatment system to remove heavy metals from the geothermal fluids; and,
- Construct approximately 5,400 feet of discharge pipeline to the Pit River for disposal of the geothermal fluids.

The proposed geothermal district heating project would be capable of supplying space heating and hot potable water for homes in the I'SOT community. The proposed district heating system includes production of geothermal fluid from an existing well to supply geothermal hot water to a heat exchanger facility. The heat exchanger is designed to extract the heat from the geothermal water and transfer that heat to water in the district heating pipeline. The district heating system would deliver the heated water to individual heating coils and domestic hot water supply tanks located in 36 separate buildings connected to the district heating system (Figure 2.2-2). The geothermal fluid remaining after heat exchange would be filtered to reduce levels of naturally occurring mercury. Before discharge to the Pit River, additional heat would be taken from the effluent by circulating it through a 4,000 ft. concrete slab of the food service/laundry building. Discharge into the Pit River would be through approximately 5,400 ft. of discharge pipeline and an existing multi-port diffuser pipe to enhance the mixing of the geothermal and Pit River water.

The Central Valley Regional Water Quality Control Board (CVRWQCB) has approved discharge of the geothermal fluids to the Pit River. The I'SOT project has obtained a National Pollution Discharge Elimination System (NPDES) Permit (No. CA 0084859) and CVRWQCB has issued Waste Discharge Requirements for conditional discharge of the geothermal fluid.

Geothermal Resource

The geothermal fluid would be drawn from I'SOT's 2,105-foot deep production well (ISO-1). Fluids from this well have temperatures from 180^{0}F to 200^{0}F and would be piped aboveground to a central mechanical equipment and control building on site.

Heat Exchangers

The district heating system is designed to use the heat from the geothermal groundwater to heat domestic water that is then used in water heaters and space heating. There would be two heat exchangers and a backup boiler located inside the mechanical building. The primary (HE-1) and secondary (HE-2) heat exchangers use a series of stainless steel plates, which are set in a series within a frame. Heat is transferred from the primary loop to the secondary loop through the plate-and-frame exchanger. The heat exchanger is designed to keep the geothermal fluids separate from the circulating potable water (fluid to be heated), to prevent the geothermal fluids from depositing scale or causing corrosion of the heating systems piping, and to prevent contamination of the heating fluid.

The district heating system's heating water would be transferred to each individual building by a distribution pipeline. Additional heat exchangers and radiant heaters in each building serve to heat air for space heating and water for domestic use. After heating the buildings on the system, the district heating water returns to the central heat exchanger for reheating and continued circulation back through the districting heating system. Adding cold water from the potable water system from a private community well into the direct heating system would make up any losses from consumptive use of hot water. The amount of make up water needed for domestic use is approximately 3,660 gallons per day (gpd).

Backup Boiler System

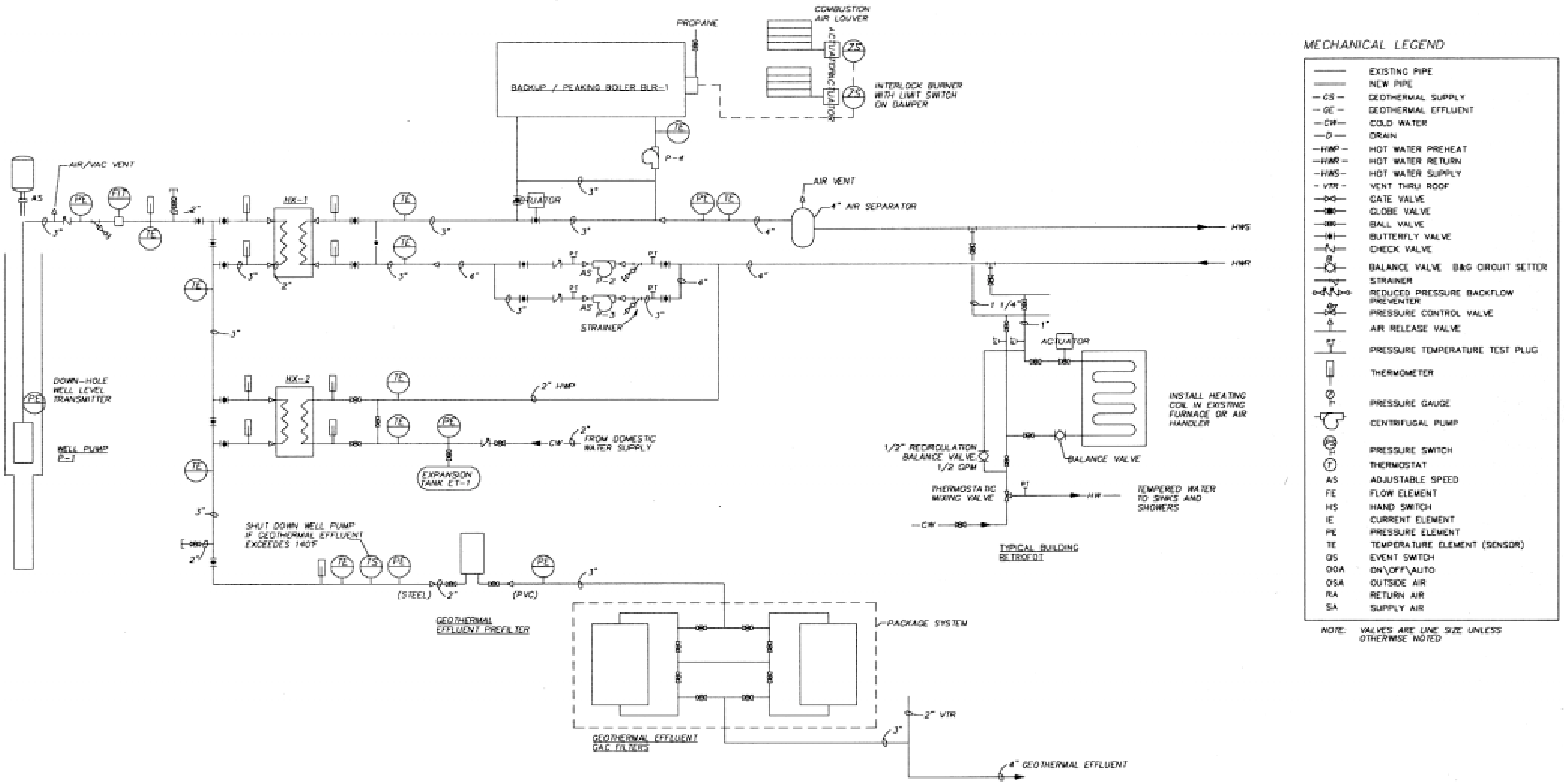
A centrally located backup/peaking boiler would be provided to act as a backup system should the geothermal heating system be taken offline for maintenance or repair during a high heating demand period and during river flows below 3 cfs, as according to the I'SOT NPDES requirements. The boiler would be copper-tubed and rated for potable water. The boiler would provide peaking or supplemental heating during periods of extreme cold weather or if the well capacity is less than the heat demand. Boosting the supply water temperature with the boiler would increase the heating capacity of all the heating coils in the district heating system and provide the extra heat needed in extreme weather. The boiler would be designed to provide full backup heating at maximum design conditions.

The backup boiler would be interconnected to the district heating circulating hot water system and would start operations whenever the district heating system water temperatures fall below the desired minimum temperature. The propane boiler would require a 1,500 to 2,000 gallon propane storage tank to provide one week's backup operation at peak rated rates. The boiler is anticipated for use approximately 1% to 2% of the year when temperatures fall below 7°F.

Computer Controls

The geothermal district heating system is operated by central computerized control systems, which consist of a series of computerized microprocessors that are used to monitor heating demand and to keep well flow rates and heat exchanger flow rates synchronized with the heating loads of the district heating system.

Figure 2.2-2: District Heating System Schematic



SOURCE: Merrick 2002

Geothermal Fluid Disposal

Geothermal water leaving the central heat exchanger is filtered and then disposed of through a pipeline to the Pit River. At the Pit River, an existing diffuser pipe at the discharge point mixes the filtered geothermal fluid with the Pit River water.

2.2.3 CONSTRUCTION

Geothermal Well and Geothermal Reservoir

No construction is required related to the geothermal well. I'SOT's existing, previously approved well would be used to provide geothermal fluids for the described district heating system (Figure 2.2-3). The Division of Oil, Gas and Geothermal Resources approved the 2,105 ft. deep well in September 1999 (DOGGR 1999).

The geothermal well was drilled in April 2000 into a formation of fractured lithified volcanic tuff of the Alturas Formation. The geothermal fluids are believed to be produced from fractured cemented fine-grained tuffs of the Alturas Formation in the interval below 1,900 ft, though most production is probably from a fracture zone around 2,050 ft. depth (Bohm 2000). The well is lined with a steel casing, which is cemented to the surrounding rock formations. The casing and cementing are designed to prevent intermingling of the geothermal water with shallower, potable groundwater. A deep well line-shaft turbine pump would be set at approximately 250 ft. into the well.

An 8 ft. by 6 ft. room attached to the main mechanical building would be constructed around the wellhead. This is a "separate" room and would have only three walls and share airspace with the main building. When the pump needs to be serviced, the 6' X 8' building would be removed as a unit and replaced after work is completed.

Figure 2.2-3: Existing Geothermal Well – ISO-1

SOURCE: MHA 2002

Food Service/Laundry Building

A new 4,000 sq. ft. community laundry and food service storage building would be constructed near the central mechanical building to take advantage of the geothermal district heating system hot water for laundry and other washing needs. The space heating needs would be served by circulating the spent geothermal fluid through the building's concrete slab on the way to discharge. The 21 ft. high building would be placed on the west side of County Road 161, 1,100 ft. north from County Road 83. A 100 ft. by 40 ft. concrete slab would be installed. Specific components to the slab system would include a zone valve to send discharge water to six separate areas of the slab that have different heat load requirements. The system would also include manifolds, 4,000 ft. of 1/2 in. Polybutylene (PEX) piping, conduits for the geothermal water to circulate through the concrete slab and other fittings designed for radiant flooring. PEX pipe can withstand freeze-thaw conditions making it suitable for radiant floor systems. Thermostats would be placed in six locations of the building to regulate demand. A circulation pump would move the geothermal water from the main discharge line through the concrete slab, then back into the discharge line.

Mechanical and Control Building

The building would be approximately 20 ft. by 20 ft. in size (400 sq. ft.) and would house the major equipment and control systems for the district heating system. The 16 ft. high building would house the geothermal well production pump, carbon filters, heat exchangers, backup/ peaking boiler, heating water loop circulation pumps, and central control system. A 408 sq. ft. concrete slab, electrical equipment, and the pre-engineered steel building would be constructed 1000 ft. north on County Road 203 from County Road 83.

District Heating System

Distribution pipelines would be constructed with a backhoe or excavator to trench the distribution pipelines. A 2 ft. wide by 4 ft. deep trench would be dug. The trench would be cut along the designated route and would be graded to allow for gravity draining. Excavated materials are removed and taken away a short distance and sifted to remove large rock. The trench bed is then filled with 6 to 10 inches of <1.5-inch gravel (gravel 1.5 inches or smaller). This gravel is used to form a level bed for the pipe. The pipe is laid in the trench on the gravel and then buried with the sifted earth material. Dump trucks would be used to haul out excess excavated material and bring in bedding for the pipeline. The construction corridor would be approximately 25 ft. wide. Lateral pipelines can be placed with trenching equipment and would require a 10 ft. construction corridor. A water truck would be used on site to control fugitive dust during construction.

Distribution pipes would vary in size and length as required to reach individual buildings. The districting heating system would include the following pipe lengths and size:

Table 2.2-1: Description of Piping for Distribution and Discharge Lines

Length	Size	Type
320 feet	4 inch	Preinsulated copper pipe, Type-L Equipment Pipe
3520 feet	3 inch	Preinsulated copper pipe, Type-L Distribution Pipelines
1560 feet	2 inch	Preinsulated copper pipe, Type-L Distribution Pipelines
1320 feet	1.5 inch	Preinsulated copper pipe, Type-L Lateral Pipelines

SOURCE: Merrick 2002

Thirty-four existing buildings would be retrofitted with air intake louvers and door sweeps. Hot water heating coils would be added to existing forced air heating systems to provide space heating. The required water supply and return temperature for these coils sets the design conditions system wide affecting heat exchanger size, pipe and pump sizing and overall system capacity. For the kitchen dishwashers, the hot water would flow through existing water heaters for temperature boosting if needed. At other locations, the existing water heaters would be bypassed or removed. A circulation pump distributes the heated service loop water throughout the district heating system. Only one circulation pump works at a time, as the second pump is utilized as a backup. The service loops of potable water uses the circulation pumps to circulate water into HE-1. The heated water temperature drops to 160°F, then is pumped to the residents at 110°F.

Figure 2.2-4 shows a plan view of the existing facilities with the proposed new buildings and distribution lines.

Granular Activated Carbon Filters

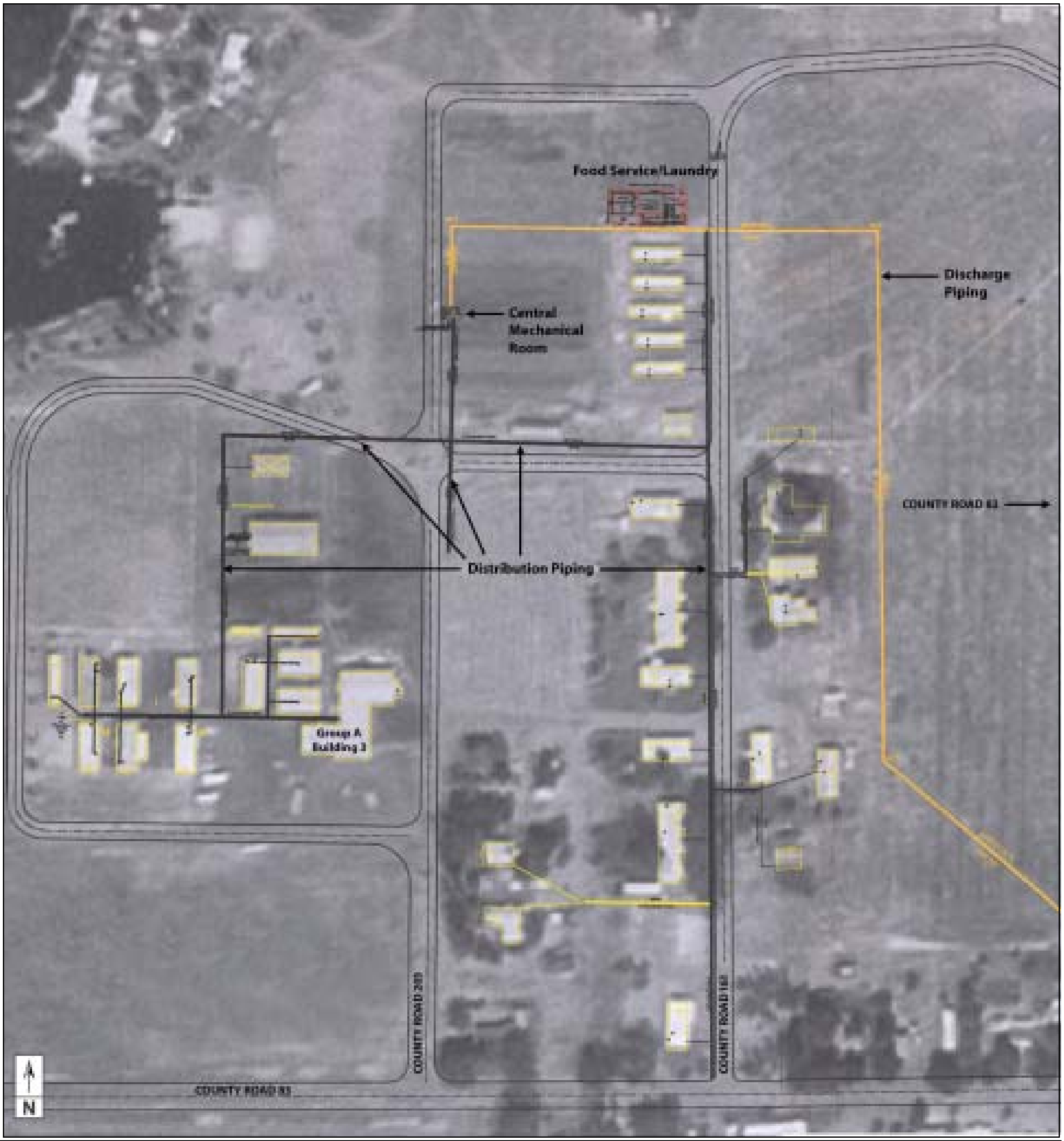
The activated carbon filters would be installed inside of the mechanical and control building. These filters would be designed to reduce levels of mercury from the geothermal water prior to discharging the geothermal fluid to the Pit River.

Discharge Pipeline

Geothermal fluid from the carbon filter unit would discharge into a 5,400 ft. long discharge pipeline. The proposed route for the pipeline crosses fields, runs along a levee road, and traverses a small portion of wetlands owned or controlled by the I'SOT community (Figure 2.2-5). The 4-inch pipeline would be buried approximately 3 ft. below the surface. A 25 ft. construction corridor would be needed to excavate the 3 ft. by 4 ft. deep trench. A backhoe or an excavator would be used to dig the trench. At the narrowest point, the width of the levee road is 12 ft. and the maximum width is 20 ft. The road is approximately 760 ft. long from the base of the hill to the bank of the Pit River. The levee road is always dry except during a rainstorm.

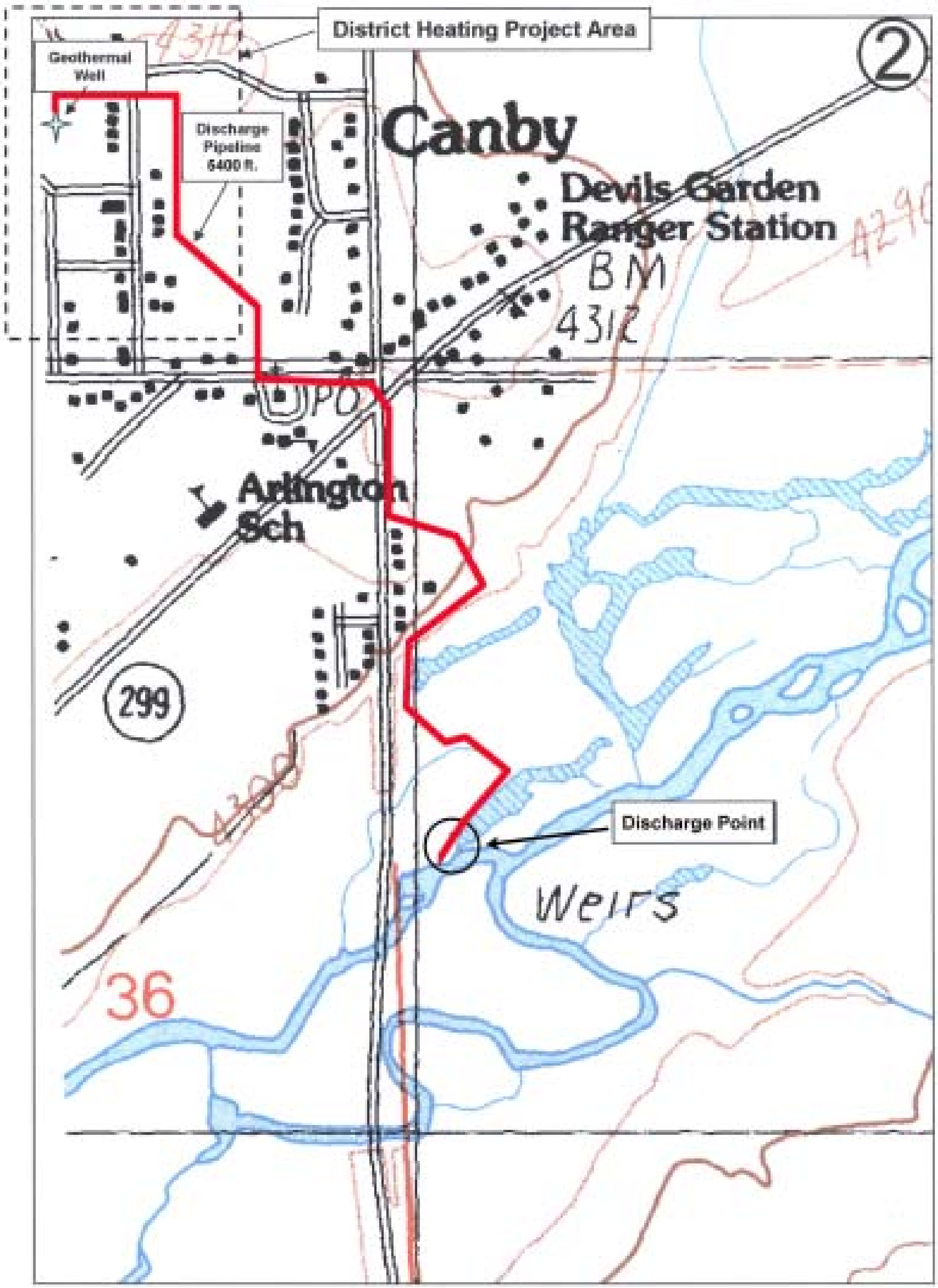
Excavated material would be used as overburden on the pipeline. Bedding material would be brought to the construction site by dump truck and excess excavated material removed or spread on site. The pipeline would be constructed utilizing bell and spigot type 4" PVC plastic pipe.

Figure 2.2-4: Plan View of District Heating System



SOURCE: Merrick and MHA 2002

Figure 2.2-5: Proposed Discharge Pipeline Route



SOURCE: Merrick 2002

Construction Schedule

The construction schedule for the proposed action (Table 2.2-2) assumes initiation of the project immediately following project approval. The schedule includes the following specific construction constraints imposed by environmental and land use issues in the project area:

- As mitigation to avoid increased impacts to wetland vegetation and soils, construction of the discharge pipeline should occur during the driest period-typically from March to May.

Table 2.2-2: Tentative Project Schedule

I'SOT Geothermal District Heating Demonstration Project
Accelerated Tentative Project Schedule

NREL Task	Description	Timeline
Phase I NREL Environmental Process	NREL to complete environmental work for construction.	September 2002 to February 2003
Task 4a Mechanical Building	Place concrete slab, erect steel building, install electrical.	March 2003
Task 4b Mechanical Equipment	Install production pump, carbon filters, heat exchangers, boiler, circulation pumps, controls, etc.	April 2003
Task 4f Remodel / Maintenance	This task would maintenance existing heaters and furnaces, ductwork, install air intake louvers, door sweeps, etc.	February to March 2003
Task 4c Distribution Piping	Excavate trenches, install all valves, valve boxes, pre-insulated piping, etc., bed, backfill, compact.	March to May 2003
Task 4d Retrofits	Install mixing valves on water heaters, coils in furnaces, some sheet metal work on furnaces.	March to April 2003
Task 4e Discharge Piping	Excavate 2' wide trench from Mechanical Building to Pit River, install a 4" bell and spigot PVC pipe, bed, backfill, compact.	March to May 2003

Table 2.2-2: Tentative Project Schedule (continued)

I'SOT Geothermal District Heating Demonstration Project
Accelerated Tentative Project Schedule

NREL Task	Description	Timeline
Task 5 Instrumentation	Install controls in mechanical building and on retrofits.	March to May 2003
Task 4h FS /Laundry Slab	Place concrete for a 100' x 40' slab and install manifolds, PEX piping, etc., for radiant flooring.	June to July 2003
Task 6 Startup and Checkout	A checklist of performance parameters would be prepared by the project engineer and verified at system startup. Project engineer would troubleshoot possible system problems.	June 2003
N/A	Test water quality per NPDES discharge requirements.	June 2003
Task 7 Performance Monitoring and Evaluation	Operation of the system would be monitored for 2 years after startup with all data being sent to NREL for evaluation.	July 2003 to July 2005
Task 8 Technology Transfer & Outreach	Technical presentation would be presented, results of project published.	For CEC June 2003 For NREL after 2003

SOURCE: Merrick 2002

2.2.4 OPERATION

Geothermal well

An open, drip-proof motor set at the surface would power the pump. Motor and pump speed would be adjustable, and controlled based on well flow level and demand requirements. Pump tests yielded a maximum flow rate of approximately 41 gallons per minute (gpm) indicating a high production rate. The system design is capable of pumping 60 gpm. Well water levels would be continuously monitored to allow pump operations up to the well capacity without drawing the well below a safe pumping level. The expected annual average flow rate for the district heating system is approximately 15 gpm and a peak flow rate of 37 gpm.

Food Service/Laundry Building

The 110°F discharge water from the mechanical building would be routed past the food service/laundry building in order to take advantage of the waste energy by circulating this water through the building's concrete slab. For laundry use, the district heating hot water would be used directly or mixed to an appropriate temperature.

Mechanical and Control Building

Two heat exchangers and a backup boiler would be located in the mechanical and control building. The geothermal wellhead would be adjacent to the main building as described above. The heat exchangers would be used to obtain the maximum heat extraction from the geothermal fluids. The two heat exchangers would be constructed of stainless steel to avoid corrosion by the geothermal fluid.

Primary Heat Exchanger. The primary heat exchanger (HE-1) would be used to heat returning water from the district heating system and to heat make-up domestic hot water. At design conditions, a flow of 37 gpm of geothermal fluid would be cooled from 190° to 110°F in HE-1. This would result in a heating of about 59 gpm of district heating system water from 100° to 150°F. HE-1 would be hydraulically sized for a flow of 80 gpm.

Secondary Heat Exchanger. From HE-1, the geothermal fluid would flow through a secondary heat exchanger, HE-2. HE-2 would be used to preheat the make-up water for domestic hot water supply. As potable hot water is consumed from the circulating hot water system, colder make-up water would be added to the system after being pre-heated by the geothermal fluid in the secondary heat exchanger HE-2. This heat exchanger provides substantial heating capacity to meet peak hot water demands. At a peak hot water flow of 30 gpm, assuming 80°F make-up water temperature, the heat exchanger would provide significant preheat energy, without increasing the geothermal pumping rate.

Backup Boiler System. The centrally located backup/peaking boiler would provide better control and more efficient supplemental heating than relying on the existing distributed furnaces and water heaters. The boiler at the mechanical building gives the opportunity to provide peaking to supplement geothermal heating during extreme cold weather or if the well capacity is less than the heat demand. With distributed backup heating, the choice to go to backup heat on an individual heater would require shutting off the geothermal supply to that heater. Supplementation is not feasible because the hot water coils would be located after the furnace. The boiler would be designed to provide full backup heating at maximum design conditions.

A standard package industrial propane boiler would be located in the mechanical and control building and discharge through a short stack to the atmosphere. The backup boiler would interconnect to the district heating circulating hot water system and would start operations whenever the district heating system water temperatures fall below the desired minimum temperature. The propane boiler would require a 1,500 to 2,000 gallon storage tank to provide one week's backup operation at peak rated rates.

District Heating System

Initially, 34 units would be connected to the district heating system. Later, the proposed 4,000 sq. ft. community laundry and foodservice storage building would be constructed near the central mechanical building and also receive heated water. The location of the building would take advantage of the geothermal district heating system for space heating and hot water for laundry and other domestic needs**.** The heated water would circulate from the heat exchangers through an underground pipeline to each building in the heating district.

Heat loss calculations have been completed for each building and different size coils have been designed for the various ranges of heat loads (Brown 2002)**.** Several structures are older mobile homes heated with gas furnaces. In other structures the hot water heating coils would be added to existing forced air heating systems to provide space heating.

Water Circulation Pumps. The water circulation pumps would be made of brass or other material suitable for hot potable water. The pumps would be sized for up to 80 gpm each with 3 horsepower high efficiency inverter motors. This sizing allows a single pump to meet the peak flow providing installed backup pump ability.

Potable Water Heating. The potable hot water would be provided directly from the circulating district heating system water. Hot water used for showers and other direct contact uses, the hot water would be mixed down to 120^{0}F through an anti-scald valve. For kitchen dishwashers and laundry use the hot water would flow through the existing water heaters for temperature boosting if needed. Use of the heating water directly as potable hot water requires the entire heating water system be designed to potable water standards.

Pumps, piping, valves and heating coils would be rated for direct contact with potable water. Make-up water for potable hot water would be added at the heat exchanger building, where the make-up water is preheated with geothermal effluent from the main heat exchanger**.** The heating water distribution piping system contains about 2,400 gallons of hot potable water, which can help meet peak demands for hot water anywhere in the system.

Granular Activated Carbon Filters

The geothermal resource contains about 187 nanograms per liter (ng/L) of mercury. The geothermal fluid discharged from the secondary heat exchanger would be sent to a skid-mounted granular activated carbon (GAC) filter to reduce the mercury content prior to discharge of geothermal fluid to the Pit River. Prior to the geothermal fluids being transferred to the filter skid, it would be routed through approximately 360 feet of tubing embedded in a concrete slab at the new laundry facility to lower the temperature**.** The spent geothermal fluid would then sent to the GAC filter skid.

The geothermal fluids are passed through two pressure tanks containing granularized activated carbon providing sufficient residence time for the mercury to react with the activated carbon**.** Each tank would contain about 2,000 lbs of granular activated carbon. Average discharge to the filter skid would be 15 gal/min (gpm) over a one-year period. A bench-scale study (Basic Laboratory 2002) yielded mercury reductions of 92 to 99% using the same GAC filtration proposed for this project. Retention times used in the bench scale study were significantly shorter than those proposed for the full-scale filtration system, suggesting that full-scale removal efficiencies may be not be equivalent to those observed in the laboratory. Monitoring of the system would provide actual operating efficiency ratings.

The life expectancy of the filters is currently unknown, but water analysis would be conducted on a monthly basis to determine continued efficiency. When breakthrough occurs in the lead vessel, US Filter would swap out the vessels as needed, putting the lag vessel as the lead and putting the new vessel in the lag position.

The skid-mounted carbon filter consists of two pressure tanks and circulating pumps. The skid is approximately 8 feet by 3 feet by 10 feet and would be located in the central mechanical and control building at the wellhead. Effluent from the activated carbon filter would flow to the discharge pipeline.

A licensed vendor would clean the filters periodically and the contaminated carbon replaced with fresh activated carbon. The vendor would process the contaminated carbon for mercury recovery. Discarded filter material would be treated as a hazardous material by the vendor and disposed of in a Class 1 landfill.

Discharge Pipeline

Although the geothermal effluent is pumped into this pipeline, the pipe would drain by gravity and would run at atmospheric pressure. The proposed route for the pipeline crosses fields, runs along a levee road, and traverses a small portion of wetlands owned or controlled by the I'SOT community. See Figure 2.2-5 for a map of the proposed route. Figures 2.2-6 and 2.2-7 show the corridors for the pipeline.

Discharge to Pit River

Prior to discharge to the Pit River the geothermal effluent would be reduced in temperature from 100^{0}F to 80^{0}F and pass through a diffusion manifold at a point approximately 425 feet upstream from the County Road 54 Bridge at a temperature below 80^{0}F. The maximum flow rate would be 60 gpm based on NPDES permit restrictions, although the flow rate of the well is 37 gpm during peak demand. The NPDES permit discharge limits are set at 50 ng/L mercury, 600 µg/L boron, and 150 µg/L of arsenic daily maximum, at 80^{0}F for a flow rate of 60 gpm.

The mercury filter system is expected to capture between 92% and 99% of the mercury and discharge rates of mercury are expected to be closer to 4 to 7 ng/L based on 37 gal/min flow rates. At maximum capacity rate of 60 gal/min the mercury discharge rate is expected to be 10.5 ng/L. Temperature of discharged water is also expected to be less than 80^{0}F because the discharged water would travel through an energy disperser to heat a concrete slab and travel through the carbon filter tanks for approximately 35 minutes residence time prior to traveling approximately 5,400 feet to the discharge diffuser.

2.2.5 INSTRUMENTATION AND CONTROL

An automated distributed digital control system would be used to monitor and control operations of the geothermal production and heat exchanger system as well as to monitor and control operations of all of the heating systems in all of the buildings. Computerized control of the well production rate, district heating system and geothermal heat exchanger systems is necessary in order to meet the discharge temperature requirements and to meet the heating demand of the district heating system with a limited geothermal resource.

The control system would also provide extensive monitoring capability to confirm system performance and energy savings. The standard controller would have the capability to trend up to 156 data points, with a permanent record saved to a computer hard disk. Additional trends are possible with more control system memory. A modem would provide remote access for monitoring, alarms and system maintenance.

2.2.6 DECOMMISSIONING

Plans for Reclamation

The district heating system should have a 40 to 50 year life cycle and with repair and maintenance the system could be used for hundreds of years. The Boise, Idaho geothermal district heating system has been in continued used since the 1870's. Decommissioning would involve removal of the mechanical equipment from the central heating plant. This equipment could be salvaged to recover the metal in the plate heat exchangers. Upon decommissioning, the geothermal well would have to be plugged and abandoned in accordance with Department of Oil, Gas and Geothermal Resources (DOGGR) regulations. The mercury filter would be removed from the project site, and if not salvaged, then sent to a Class I hazardous materials land fill. The pipelines would be left buried with caps or put to other uses such as carrying irrigation water.

2.3 Project Evolution

DOE's alternatives are to fund or not fund the proposed project. In considering the environmental issues associated with the project, DOE worked with I'SOT to identify alternative pipeline routes that would reduce environmental effects. As a result of DOE's involvement there have been positive changes made to the project. The following project alternatives were investigated by I'SOT when designing the project and were eliminated due to feasibility issues. Reasons for the alternative elimination included currently prohibitive cost, effects to biological resources, and effects to Modoc County infrastructure.

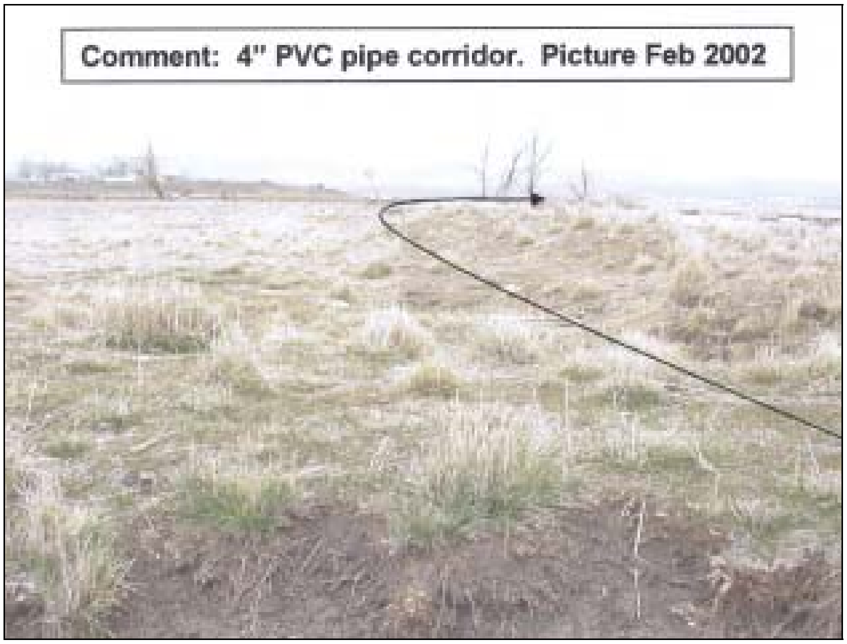
2.3.1 INJECTION NOW/NO DISCHARGE TO PIT RIVER

The proposed project does not include an injection well for the disposal of the spent geothermal fluid after heat exchange. Drilling of an additional well in the general vicinity for injection of the spent geothermal fluid would cost an additional estimated $555,000 compared to the 5,400 ft. of underground pipeline which would cost approximately $34,000, a difference of $521,000. This estimate was derived from a memorandum to the Modoc Joint Unified School District Board of Trustees from Dr. Kevin J. Jolly, Superintendent regarding the history and current feasibility of Geothermal Well AL-2 (Jolly 2002). The second well for injection was considered by the I'SOT community to be cost prohibitive. At this time, neither I'SOT nor the DOE geothermal program has the finances for the cost of the injection well. An NPDES Permit has been obtained for the discharge of the geothermal water into the Pit River.

2.3.2 DISCHARGE OF EFFLUENT TO A CREATED WETLANDS

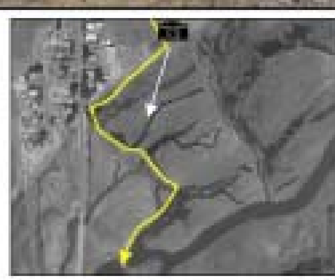
The pipeline was originally designed to discharge to a section of wetlands that would act as a biofilter for the geothermal effluent. This wastewater-type wetland filter was eliminated because it would alter and degrade the type of jurisdictional wetlands in the project area due to uptake of metals by vegetation. Wildlife foraging in the wetlands could potentially be affected by vegetation with metal accumulation. I'SOT consulted with Jim Rohrbach of the RWQCB regarding this alternative. The alternative was deemed unacceptable due to metal concentration build-up on the land surface that could potentially affect groundwater.

Figure 2.2-6: Corridors for the Pipeline (dry grazing land)



SOURCE: Merrick 2002

Figure 2.2-7a: Corridors for the pipeline (Levee Road). Looking southwest at the proposed pipeline route.



(Camera and arrow icon indicate where the picture was taken)

SOURCE: Merrick 2002

Figure 2.2-7b: Corridors for the pipeline (Levee Road). Composite picture of proposed pipeline re-route to discharge area (looking South).

(Camera and arrow icon indicate where the picture was taken)

SOURCE: Merrick 2002

2.3.3 DISCHARGE PIPELINE ROUTE THROUGH WETLANDS

The pipeline was originally designed to traverse a path on lands owned by I'SOT. An alternate path for the discharge pipeline would traverse a much greater portion of wetlands than the proposed path. An estimated 1,083 feet (0.62 acres) of wetlands would be affected by trenching this pipeline route. Complications with trenching through the wetlands, temporary effects to wetlands, and the increased likelihood of encountering special status species make this an undesirable alternative. The proposed project would affect 0.03 acres of wetlands.

2.3.4 DISCHARGE PIPELINE ROUTE ALONG COUNTY ROAD

An alternate path for the discharge pipeline would go along County Road 54, involve a bridge crossing, and traverse a small section of wetlands before reaching the discharge point at the Pit River. This alternate path could affect the public if the pipeline leaked or failed, would require additional CEQA analysis, and would require an encroachment permit from Modoc County. The project proponents prefer to keep the entire project on I'SOT property. This alternative was rejected because the environmental impacts to wetlands were greater than the proposed route. An estimated 198 feet (0.11 acres) of wetlands would be affected by trenching this pipeline route as opposed to the 45 feet (0.03 acres) for Alternative A.

2.4 No Action Alternative

Under the "No Action" alternative, the proposed district heating system would not be funded by NREL/DOE. The proposed project would proceed if alternative funding was secured by I'SOT, with effects from Alternative A potentially worse without DOE participation because no mitigation would be required (except NPDES required items). Without funding by DOE, I'SOT would not be reimbursed for costs resulting from permitting efforts, engineering consultation, and system installation costs. No data gathering system would be installed for DOE research and development (R&D) purposes. NREL would provide approximately 50% of the total project budget.

2.5 Impacts and Mitigation Measures

The proposed project could have the potential for adverse environmental effects. The following table summarizes measures that have been proposed as project conditions and would be incorporated as part of the proposed action prior to DOE approval.

Table 2.5-1: Summary of Monitoring and Mitigation Measures Considered as Project Conditions

Impact Type	Impact	Mitigation Measure	Level of Significance without Mitigation	Level of Significance with Mitigation
Air Quality	Dust emissions	**4.1-1**. I'SOT will limit all construction vehicles to 25 miles per hour or less on all unpaved roads to minimize dust generation.	Potentially Significant	Less than significant
Air Quality	Dust emissions	**4.1-2.** I'SOT will ensure that watering for dust suppression shall be applied throughout the construction area during the construction period. I'SOT will also ensure that watering is applied for dust suppression at the dumpsites for excavated material during dumping of excess excavated material.	Potentially Significant	Less than significant
Air Quality	Dust emissions	**4.1-3**. I'SOT will ensure that dump trucks used to transport bedding and trenching material shall be equipped with adequate cover material to prevent particulates from scattering along the transport route. I'SOT will also ensure that this cover material shall be used when transporting project-related bedding and trenching material. In addition, I'SOT shall ensure that watering for dust suppression shall be performed at dumpsites for excavated material during dumping of excess excavated material.	Potentially Significant	Less than significant
Hydrology	Potential for spills	**4.3-1**. I'SOT will design and construct the pipeline according to standard engineering practices and codes such as American Water Works Association (AWWA) or American	Potentially Significant	Less than significant

Table 2.5-1: Summary of Monitoring and Mitigation Measures Considered as Project Conditions

Impact Type	Impact	Mitigation Measure	Level of Significance without Mitigation	Level of Significance with Mitigation
		Society of Mechanical Engineers (ASME) Power Piping Code B31.1.		
Hydrology	Potential for groundwater contamination from pipeline breakage	**4.3-2**. I'SOT shall inspect the pipeline route on a monthly basis for possible pipeline damage generated from surface activities such as construction. Potential damage will be investigated and repaired, if necessary. I'SOT shall, upon pipeline installation and on an annual basis thereafter, perform a pressure test of the discharge pipeline. The pressure test shall involve blocking the pipeline at the discharge point such that no discharge escapes, filling the pipeline with water, and observing the water level at the head of the pipeline over time. A fall in water level indicates a leak in the pipeline and shall be followed by shutdown of the geothermal flow. Use of the discharge pipeline shall not recommence until the leak is identified, repaired, and a further pressure test indicates the pipeline is sealed. The leakage limit will be will be set as the manufacturer's estimate for leakage under the project's operating conditions. I'SOT shall provide the results of this testing to NREL during the first 3 years of operation.	Potentially Significant	Less than significant
Hydrology	Water quality and wildlife	**4.3-3.** The WDR sets 50 ng/L as the limit for mercury concentration in the effluent to be protective of water quality and wildlife. The GAC filter system removes 92-99% of incoming mercury yielding effluent mercury levels within a 2-19 ng/L range. Higher concentrations in the effluent may suggest declining filter efficacy. I'SOT will replace the GAC filters according to manufacturer's specifications. The mercury concentration in the effluent will be monitored monthly for the first six months and quarterly thereafter. If mercury concentrations in the effluent are found to be 45 ng/L, I'SOT will replace the GAC filters.	Potentially Significant	Less than significant
Biology	Vegetation and soil disturbance	**4.4-1.** To minimize the impacts to removed vegetation in the wetlands and other areas,	Significant	Less than significant

Table 2.5-1: Summary of Monitoring and Mitigation Measures Considered as Project Conditions

Impact Type	Impact	Mitigation Measure	Level of Significance without Mitigation	Level of Significance with Mitigation
	soil disturbance	during trenching, I'SOT will ensure that soil will be placed on either side of the trench. As much of the soil with its original vegetation as needed to return the ground to the original contour will be replaced immediately after the pipeline installation is completed. Due to the bedding material and pipe diameter, all of the removed soil will not refill into the trench; however, the fill soil will contain enough of the original vegetation to retain plant growth.		significant
Biology	Drainage to wetlands	**4.4-2.** To reduce likelihood of affecting drainage in the wetlands, I'SOT will carefully plan the timing of project implementation. I'SOT will perform construction activities adjacent to drainages and wetlands when the probability of heavy rain is minimal and inundation of the project wetlands is reduced due to manipulation of the weirs. This driest time, when construction would be carried out, falls between February and March. Replacement of weir boards occurs on April 1st, causing the drained wetlands to be re-saturated by the summer months.	Significant	Less than significant
Biology	Damage to eel-grass pondweed	**4.4-3.** I'SOT will place a sedimentation barrier fence adjacent to and on either side of the trench through the 0.03 acres of wetland. The fence shall remain in place until the construction is complete to prevent sediment from collecting on and damaging any eel-grass plants.	Significant	Less than significant
Biology	Pit River mercury concentration effects to fish and wildlife	~~**4.4-4.** The concentration of mercury in the effluent will be monitored monthly. The Pit River water concentration will also be monitored monthly at two stations, one 50 feet upstream from the point of discharge and the other 425 feet downstream from the point of discharge as stated in the NPDES permit.~~ ~~If the mercury concentration in the effluent exceeds the permit level of 50 ng/L, the proponent will coordinate with the RWQCB, CDFG, and USFWS to determine appropriate mitigation. Measures to reduce the effect~~	Significant	Less than significant

Table 2.5-1: Summary of Monitoring and Mitigation Measures Considered as Project Conditions

Impact Type	Impact	Mitigation Measure	Level of Significance without Mitigation	Level of Significance with Mitigation
		~~could include, but are not limited to, temporary cessation of discharge temporary collection and proper disposal of discharge until the concentrations decrease, alternative filter systems, or injection of the spent geothermal fluids back into the geothermal reservoir.~~ I'SOT shall monitor the concentration of mercury in the effluent monthly for six months and quarterly thereafter Refer to Mitigation Measure 4.3-3 (Hydrology and Water Quality) for requirements for replacement of the GAC filters. I'SOT shall also monitor the Pit River water concentration monthly at two stations, one 50 feet upstream from the point of discharge and the other 425 feet downstream from the point of discharge as stated in the NPDES permit. I'SOT shall provide test results to NREL for the first 3 years of operation. If the mercury concentration in the effluent exceeds the permit level of 50 ng/L, if concentration in the river exceeds 50 ng/L, or if assessment of the monitoring activities (including chronic toxicity testing, and fish residue analysis) suggests that discharge may result in significant increase in risk of mercury bioaccumulation in fish tissue I'SOT shall coordinate with the RWQCB, CDFG, and USFWS to determine appropriate mitigation. Measures to reduce the effect could include, but are not limited to, temporary cessation of discharge temporary collection and proper disposal of discharge until the concentrations decrease, alternative filter systems, or injection of the spent geothermal fluids back into the geothermal reservoir.		
Biology	Effects of mercury bioaccumulation in fish tissue and bald eagles	**4.4-5.** In accordance with the NPDES permit, I'SOT shall collect samples of Sacramento pike-minnow or other appropriate species will be collected and whole body concentrations of mercury will be determined at least every other year. I'SOT shall devise a sampling plan with the species	Significant	Less than significant

Table 2.5-1: Summary of Monitoring and Mitigation Measures Considered as Project Conditions

Impact Type	Impact	Mitigation Measure	Level of Significance without Mitigation	Level of Significance with Mitigation
		of fish, number to be collected, the age of the fish and the method of aging in consultation with USFWS and CDFG. The sampling plan and protocol shall be submitted to the Executive Officer of the CVRWQCB, USFWS, and CDFG for approval. ~~If fish tissue concentrations exceed 100 ng/g, then the proponent will coordinate with the RWQCB, CDFG, and USFWS to determine appropriate mitigation. Mitigation measures might include those measure outlined in Measure 4.4-4 to reduce mercury discharge to the river, as well as actions to improve or enhance local eagle foraging or nesting conditions in the area, as coordinated with USFWS and CDFG.~~ Current levels of mercury in fish tissue average 0.4 ng/g. The maximum projected increase in fish tissue concentration is to 0.895 ng/g. If the tissue mercury concentration averages above 5 ng/g, then the proponent will coordinate with the RWQCB, CDFG, and USFWS to determine appropriate mitigation. Mitigation measures might include those measure outlined in Measure 4.3-5 to reduce mercury discharge to the river, as well as actions to improve or enhance local eagle foraging or nesting conditions in the area, as coordinated with USFWS and CDFG.		
Cultural Resources	Potential to affect undiscovered resources	**4.5-1**. During pipeline installation I'SOT shall contract for a tribal monitor check for any Indian cultural resources or human remains. Mitigation to avoid effects to resources encountered might include avoidance or data collection.	Potentially Significant	Less than significant
Cultural Resources	Potential to affect undiscovered resources	**4.5-2**. Should any prehistoric or historic resources be encountered during site construction activities, I'SOT shall suspend construction activities within 50 feet of the discovery until a qualified consulting archaeologist has assessed the materials. If a decision is made to record the site, I'SOT shall ensure that recordation shall take place and it will be determined whether project well sites could be relocated to avoid any	Potentially Significant	Less than significant

Table 2.5-1: Summary of Monitoring and Mitigation Measures Considered as Project Conditions

Impact Type	Impact	Mitigation Measure	Level of Significance without Mitigation	Level of Significance with Mitigation
		additional effects. I'SOT shall not resume construction activities in the vicinity of the discovery until consultation has taken place and the resources have been appropriately evaluated or treated and specific authorization to resume construction activities is provided by the DOE. If avoidance is not feasible, I'SOT shall ensure that a qualified archaeologist will evaluate the site and a determination of eligibility for the NRHP shall be made. If the site is determined to be eligible, then I'SOT shall submit a mitigation proposal (which may include a data recovery program similar to those conducted for similar resources in the vicinity) with the site record to the SHPO for review and concurrence.		
Cultural Resources	Potential to affect undiscovered remains	**4.5-3**. If prehistoric archaeological deposits that include human remains or objects considered "cultural items" according to the Native American Graves Protection and Repatriation Act (NAGPRA) are discovered during site construction activities, I'SOT shall immediately notify the County Coroner and a qualified archaeologist and would follow NAGPRA regulations. If the remains are identified as American Indian, then I'SOT shall notify local American Indian groups or tribe(s) and the Native American Heritage Commission (NAHC) and initiate consultation. I'SOT shall ensure that the most likely descendants of these remains are notified and given the opportunity to make recommendations for the remains. If descendant recommendations are made which are not acceptable to I'SOT or DOE, then the NAHC would be requested to mediate the problem.	Potentially Significant	Less than significant
Noise	Noised impacts of construction	**4.7-1**. I'SOT will ensure that muffler systems shall be used on all heavy equipment during construction activities.	Significant	Less than significant
Noise	Noise impacts of construction	**4.7-2**. As required by the Modoc County General Plan, I'SOT will submit building permits for the project to the Modoc County Planning Department for review for	Significant	Less than significant

Table 2.5-1: Summary of Monitoring and Mitigation Measures Considered as Project Conditions

Impact Type	Impact	Mitigation Measure	Level of Significance without Mitigation	Level of Significance with Mitigation
		consistency with the noise element and other elements.		
Transportation and Traffic	Damage to roadway integrity	**4.11-1.** I'SOT will ensure that construction activities comply with all conditions of the Caltrans Encroachment Permit. These measures would minimize the chance of roadway damage during the jack and bore (HDD) process and would include the following: a. All equipment used on the paved surface of the State highway shall be rubber tired or rubber tracked, and meets the weight requirements for operation on a State highway. b. Any trench or excavation within 15 ft of the edge of the traveled way or 10 ft from the edge of pavement, whichever is greater, shall be closed. c. All work authorized herein shall be performed during daylight hours only. No work shall be performed during inclement weather. d. The minimum depth of cover over the bore casing within the State's right-of-way shall be 7.5 ft for high-risk uncased gas mains or 6 ft and 5 ft below any drainage facility. e. No open cutting of the roadway prism is permitted. f. Trenches and boring pits outside of the highway prism shall be backfilled with material approved by State's representative. g. HDD operators are required to have basic training on HDD rigs via the dealerships – Vermeer, Ditch Witch, American Auger, etc., and have proof of training in their possession. I'SOT will make a videotape before and after HDD operations to document roadway integrity has been unchanged or to determine if permittee is liable for damages to the State highway caused by his	Potentially Significant	Less than significant

Table 2.5-1: Summary of Monitoring and Mitigation Measures Considered as Project Conditions

Impact Type	Impact	Mitigation Measure	Level of Significance without Mitigation	Level of Significance with Mitigation
		operation. I'SOT will repair any damage caused by the construction, as required by Caltrans.		
Transportation and Traffic	Damage to roadway integrity	**4.11-2.** I'SOT will ensure that no vehicle used in construction or material delivery shall exceed the design load limit of the various roadways that may be used during construction.	Potentially Significant	Less than significant
Transportation and Traffic	Damage to roadway integrity	**4.11-3.** I'SOT will ensure that no construction equipment that utilizes tractor treads shall travel upon any public roadway.	Potentially Significant	Less than significant
Transportation and Traffic	Damage to roadway integrity	**4.11-4.** I'SOT will ensure that no construction equipment shall operate or park within 5-feet of either edge of a pavement edge.	Potentially Signficant	Less than significant
Human Health & Safety	Public safety during construction	**4.12-1.** Prior to project commencement, I'SOT will submit a site construction and safety plan to the Director of the Modoc County Planning Department for review and approval. The purpose of the plan shall be to ensure public safety during all phases of project construction through: a. The installation of safety signage, placed as appropriate within the construction corridor, that warns of risks associated with on-site construction activities and outlines measures to be taken to ensure safe use of facilities near construction areas and avoidance of active construction equipment b. The installation of temporary safety fencing to restrict or prevent public access to active on-site construction sites or equipment	Potentially Significant	Less than significant
Human Health & Safety	Impacts of potential spills on health and safety	**4.12-2.** Prior to project commencement I'SOT will submit to the Director of the Modoc County Planning Department for review and approval a safety plan. The purpose of the plan is to minimize the exposure of the public to potentially hazardous materials during all phases of the	Potentially Significant	Less than significant

Table 2.5-1: Summary of Monitoring and Mitigation Measures Considered as Project Conditions

Impact Type	Impact	Mitigation Measure	Level of Significance without Mitigation	Level of Significance with Mitigation
		project through: a. Appropriate methods (e.g., Best Management Practices) and approved containment and spill-control practices (e.g., spill control plan) for transport and storage of chemicals and materials on-site b. Safety signage, placed as appropriate along the construction corridor during construction or repairs, that warns of risks associated with on-site construction materials and outlines measures to be taken to ensure safe use of facilities near construction areas and avoidance of construction materials c. Temporary safety fencing during construction or repairs to restrict or prevent public access to active on-site construction materials or chemicals		
Human Health & Safety	Potential for fire risk	**4.12-3**. I'SOT will ensure that all construction equipment will be equipped with fire potential reduction equipment, such as but not limited to spark arresters, mufflers, etc.	Potentially Significant	Less than significant
Human Health & Safety	Potential for fire risk	**4.12-4**. I'SOT will ensure that fire preventative measures are taken during potentially hazardous operations, such as welding.	Potentially Significant	Less than significant
Human Health & Safety	Potential for fire risk	**4.12-5**. I'SOT will ensure that fire fighting equipment is supplied to the project site. Fire detectors, fire extinguishers, and hand-held fire fighting equipment would be available and maintained at the mechanical control building as well as the food service/laundry building for the duration of the project.	Potentially Significant	Less than significant